

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
FIFTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

**Course Code: EC303**

**Course Name: APPLIED ELECTROMAGNETIC THEORY**

Max. Marks: 100

Duration: 3 Hours

*Smith Chart to be supplied.*

**PART A**

*Answer any two full questions, each carries 15 marks.*

Marks

- |   |  |         |
|---|--|---------|
| 1 | a) Point charges 5 nC and -2 nC are located at (2,0, 4) and (-3,0, 5), respectively.<br>(i) Determine the force on a 1nC point charge located at (1, -3, 7).<br>(ii) Find the electric field <b>E</b> at (1, - 3 , 7).                                   | (7)     |
|   | b) State and explain Maxwell's equations in the integral and differential forms.   | (8)     |
| 2 | a) Give Poisson's and Laplace equation in electrostatics. Give application   | (7)     |
|   | b) A plane wave propagating through a medium with $\epsilon_r = 8$ $\mu_r = 2$ has $E = 0.5e^{-z/3} \sin(10^8 t - \beta z) a_x$ V/m. Determine<br>(i) $\beta$<br>(ii) The loss tangent<br>(iii) Intrinsic impedance<br>(iv) Wave velocity<br>(v) H field | E = (8) |
| 3 | a) Derive the expression of capacitance of two wire transmission line.   | (8)     |
|   | b) State and prove boundary conditions for E and H in accordance with Maxwell's equations.   | (7)     |

**PART B**

*Answer any two full questions, each carries 15 marks.*

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|---|---|-------|
| 4 | a) In free space, $H = 0.2 \cos(\omega t - \beta x) a_z$ A/m. Find the total power passing through:<br>(i) A square plate of side 10 cm on plane $x + z = 1$<br>(ii) A circular disc of radius 5 cm on plane $x = 1$ .            | (8)   |
|   | b) Derive an expression for characteristic impedance of a transmission line and show that it is resistive at radio frequencies.   | (7)   |
| 5 | a) What is polarisation? Explain the different types of Polarisation?   | (7)   |
|   | b) A telephone line has $R = 30\Omega/\text{km}$ , $L = 100\text{mH}/\text{km}$ , $G = 0$ , and $C = 20\mu\text{F}/\text{KM}$ . At $f = 1$ KHz, obtain: i) Characteristic impedance ii) propagation constant iii) phase velocity. | (8)   |
| 6 | a) Derive the expression for the ratio of reflected to incident electric field strength for an insulator with oblique incidence.  | (7.5) |

- b) Derive the expression of input impedance due to a transmission line terminated by a load. Also find the expression for SWR. (7.5)

### PART C

*Answer any two full questions, each carries 20 marks.*

- 7 a) Derive the expression for r-circles and x-circles in Smith chart. (10)
- b) Determine, assuming TE<sub>10</sub> mode of propagation, the cut-off frequency, cut-off wavelength, guide wavelength, phase constant, phase velocity, group velocity and wave impedance in the case of a hollow rectangular metallic waveguide of dimensions 6cm and 3 cm, respectively, when the applied signal frequency is 5GHz. (10)
- 8 a) A  $100 + j150 \Omega$  load is connected to a  $75 \Omega$  lossless line. Using Smith Chart, find: (10)
- (i)  $\Gamma$
  - (ii)  $s$
  - (iii) The load admittance  $Y_L$
  - (iv)  $Z_{in}$  at  $0.4\lambda$  from the load
- b) Obtain the waveguide solution to Maxwell's wave equations. (10)
- 9 a) Explain single stub matching using analytical method. (10)
- b) A hollow rectangular waveguide has dimensions of  $a = 4\text{cm}$  and  $b = 2\text{cm}$ . Calculate the amount of attenuation if the frequency is 3.5 GHz. Assume dominant mode. (10)

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